FOCUS

The View From Moscow

A more nationalist Duma and a more assertive foreign minister, Vygeny Primakov, have come to power in Moscow. Both face serious challenges to achieving two of the foreign policy goals recently articulated by Primakov: defending Russia’s national interests and developing ties with the United States.

In one respect, the Conventional Armed Forces in Europe (CFE) Treaty is perceived in Moscow as a challenge to Russian national interests. The new treaty limits Russia’s freedom to station forces in the Caucasus at a time when additional units have been dispatched to Chechnya to fight the rebels. Despite its massive reductions of conventional military equipment, Russia still exceeds the treaty’s “faktor” (or geographic) sub-limits as a result of these deployments to the south. NATO’s proposed resolution to the problem, put forward at the last minute, would ease the flank constraints but exact a price by placing a ceiling on Russian forces elsewhere in the region.

More importantly, the CFE Treaty places overall limits on Russian armor, artillery and aircraft at a time when Washington is pressing for NATO expansion. NATO expansion would almost certainly bring Poland into the Western alliance and allow Western troops to patrol the Ukrainian and Belarusian borders. Such a change in the security calculus in Central Europe—which is controversial among the allies as well as within the United States—would make it difficult, if not impossible, for any government in Moscow to continue to abide by the CFE Treaty. Moreover, NATO expansion coupled with the already anticipated performance of Russian troops in Chechnya, could have the undesirable effect of increasing Moscow’s reliance on nuclear weapons to compensate for the weakening of the nation’s conventional forces.

Another challenge to Russia’s pursuit of improved relations with the United States is conventional enhancements in missile defense programs. On the same day that the U.S. Senate Foreign Relations Committee approved START II, a House-Senate conference committee voted to deploy a nationwide defense against strategic ballistic missiles by 2002. The legislation, subsequently vetoed, also directed the Clinton administration not to place any constraints on their own missile defense systems. If fully capable and deployed, theater missile defenses could pose a serious threat to Russian strategic forces. START II takes a healthy bite out of existing nuclear arsenals and ensures that Russian and U.S. forces remain at rough parity in an era of tight budgets and reduced force requirements. But the treaty also calls for Russia and the United States to eliminate all their multiple-warhead, land-based ICBMs; these systems represent fully 50 percent of Russia’s existing strategic deterrent forces and would be Russia’s most obvious response to deployment of a national missile defense by the United States.

In Russia, the nationalists argue that the reductions of START II, together with the deployment of missile defense systems, will simultaneously disarm, bankrupt and stigmatize the disadvantage the nation. The Russian military, which has hitherto been supportive of START II and its promise of parity at a lower cost, may well conclude that it would be ill-advised at this time to embark on a path to reduce or restructure Russia’s nuclear deterrent forces.

In light of potential changes in the European security environment and the Russian-U.S. strategic relationship, Moscow could easily opt to abandon the CFE Treaty and delay ratification of START II until it becomes clear whether NATO expansion and ballistic missile defense will proceed. But Moscow could adopt a more sophisticated approach to constrain those who support the new treaty. Klerk also announced that the IAEA had been granted full access to the facilities which had been used in the past for the development of South Africa’s nuclear deterrent and to their records of operations.

"Any doubt about the government’s intentions with regard to nuclear matters must, for once and all, be removed," de Klerk said. "For this reason, the government has decided to provide full information on South Africa’s past nuclear program despite the fact that the NPT does not require this." The unprecedented invitation to the IAEA to explore fully the details of South Africa’s Nuclear Weapons Program: From Deterrence to Dissentmament

Waldo Stumpf

On March 24, 1993, some 20 months after South Africa’s experimental nuclear detonation, the Non-Proliferation Treaty (NPT) as a non-nuclear-weapon state, South African President Frederik W. de Klerk informed a joint session of Parliament, and the world, that a single nuclear bomb had been exploded at large, that in the 1970s and 1980s the government had developed a "limited nuclear deterrent capability." President de Klerk told his audience that South Africa’s nuclear weapons program, whose objectives were to produce seven fissile devices (only six were completely assembled), had been dismantled before President de Klerk joined the NPT on July 10, 1991, and that all the country’s nuclear materials and facilities were under international safeguards.

Although South Africa had signed the requisite safeguards agreement with the International Atomic Energy Agency (IAEA) on September 16, 1991 (in advance of the 18-month deadline allowed by the NPT), and had provided the agency with a complete inventory of all nuclear materials and facilities, some speculation continued about the country’s nuclear intentions and the “completeness” of its declarations. To dispel any lingering doubts about South Africa’s commitment to the NPT, President de Klerk also announced that the IAEA had been granted full access to the facilities which had been used in the past for the development of South Africa’s nuclear deterrent and to their records of operations. “Any doubt about the government’s intentions with regard to nuclear matters must, for once and all, be removed,” de Klerk said. “For this reason, the government has decided to provide full information on South Africa’s past nuclear program despite the fact that the NPT does not require this.” The unprecedented invitation to the IAEA to explore fully the details of South Africa’s nuclear weapons program included the need to resolve regional tensions, the importance of political will and the delicate balance between international isolation and engagement.

The Beginning: Uranium Enrichment

In 1961, South Africa’s Atomic Energy Board (AEB), established by Parliament in 1948, began general nuclear research and development work at the Pelindaba Nuclear Research Center near Pretoria. In the earlier years, the AEB’s activities focused on the peaceful uses of nuclear technology. In 1965, the country’s first reactor—the U.S.-supplied SAPIF 1 research reactor—was commissioned at the Pelindaba facility.

Because South Africa was—and still is—a prominent producer of uranium, it was almost inevitable that the AEB would explore uranium enrichment technology as a means to mineral beneficiation. After achieving encouraging laboratory results with an indigenous uranium enrichment process, in 1969 the government approved the construction of a pilot plant to prove the validity of the design on an industrial scale. The design, originally similar to the so-called GWR-3 fuel enrichment process, was much closer to the ordinary centrifuge process except that the centrifuge wall was stationary above a rotating mechanism rapidly upon the uranium hexafluoride (UF6) and hydrogen gas inside a stationary tube. The uranium hexafluoride was separated by centrifugal force, and exited through different concentric holes in the ends of the tube.

On July 20, 1970, Prime Minister John Vorster informed Parliament of the government’s intention to build the pilot enrichment plant (the Y-Plant) and stressed that the technology would be used for peaceful applications. Vorster also declared Pretoria’s willingness to accept international safeguards, subject to certain conditions, including South Africa’s right to use nuclear energy for peaceful purposes, that no details of the process should become public knowledge, and that there would be no interference in the normal operations of the relevant facilities.

The newly created Uranium Enrichment Corporation, established in 1970 to oversee the program and the construction of the Y-Plant, began in 1971. The first stages at the lower end of the plant’s “cascades” were commissioned in late 1974, and the entire cascade became fully operational in March 1977. Because of the Y-Plant’s...
“equilibrium time” (the time needed to establish the full enrichment gradient over the length of the plant’s U-235) that a relatively small quantity of highly enriched uranium (HEU) was withdrawn from the plant only in January 1979. By the end of that month, the HEU that was produced was enriched to only about 80 percent uranium-235. The plant was shut down a few months later and had not reached full equilibrium.

In August 1979, V-Plant operations ceased and the reactor was taken down for a more extensive, catalytic-in-process gas reaction between the UF₆ and the hydrogen carrier gas, a mixture of hydrogen and helium. The process is expensive and wort machineable, and, when contaminated by certain impurities, can react to form uranium trihalides (UF₃) plus hydrofluoric acid. Although the relevant catalytic impurities were later identified and removed from the process, the V-Plant was not expected to resume operations until April 1980 and it was not until July 1981 that additional HEU was withdrawn. Apart from the 1979 incident, which resulted in a massive gas loss, the plant operated very smoothly during its lifetime. The V-Plant ceased operations in February 1990, and it is now being dismantled under the supervision of the IAEA.²

Peaceful Nuclear Explosions

During the 1960s, when the United States was actively studying the use of nuclear explosions as a weapon under its Plowshares Program, South Africa began studying the feasibility of employing peaceful nuclear explosives (PNEs) for mining and construction projects. When initial efforts were confined to literature surveys, in March 1971, Minister of Mines Carel de Wet gave the AEB permission to begin preliminary investigations into the feasibility of conducting PNEs after it became clear that the country’s uranium enrichment program could produce sufficient quantities of enriched uranium.

In 1974, the AEB concluded, in a report sent to Vorster, that it could successfully construct a nuclear device. That same year Vorster approved a development program for peaceful nuclear explosives that included the construction of a testing facility where underground explosions could be conducted. Although the program was directed only to peaceful and useful applications of nuclear explosive technology, the government treated it as a top secret project known as Project Codex and heavily monitored around the enrichment project and because the world was fast turning against the use of nuclear explosives for civil applications.

This became very clear with the adverse world reaction to the 1974 detonation of a nuclear device by South Africa, which it claimed was for peaceful purposes.

Political and Nuclear Isolation

During the 1970s, especially the latter half of the decade, the political and military environment around South Africa deteriorated rapidly. While White rule was increasingly restricted to its own racially based internal policies, it was exaggerated by Portugal’s withdrawal from its African colonies of Mozambique and Angola and the uncertainties about the intentions of the Soviet Union and other Warsaw Pact countries in light of their openly declared expansionist policies toward Southern Africa. The large buildup of Cuban military forces in Angola in the late 1970s, an event that eventually peaked at 50,000 troops, reinforced a strong perception within the government that it would re-isolate itself from South Africa’s territorial integrity be threatened. Moreover, increasing international re-administration on the supply of conventional arms to South Africa, again, due primarily to its nuclear policies, reinforced the perception that the country had no alternative but to develop a nuclear weapon capability to counter external threats. This was probably the most compelling government officials at the time.

Crisis with the continuing political isolation, South Africa was also isolated in nuclear affairs during the 1970s. Some of the nuclear-weapon states, in particular the United States, began applying unilateral restrictions on nuclear trade and exchanges of information and technology with South Africa. In 1976, despite a long-standing contract between the United States and South Africa, Washington halted deliveries of fuel elements for the SAFARI re-search reactor, which had been under IAEA safeguards since its commissioning in 1975. Although South Africa had already paid for the fuel elements, the Carter administration did not resume Portretia for the SAFARI reactor. In 1981, the Reagan administration approved the return of the payment.

One particularly important event in the late 1970s that undoubtedly shaped international attitudes was the discovery in August 1977 of the presence of a third plutonium source in South Africa, which was later identified as the Vapastart test site, which supposedly came to the attention of the Soviet Union and the United States through their surveillance satellites, resulted in intense diplomatic pressure on the South African government to not proceed with the construction of President P. W. Botha, the site was abandoned that same month.

The next significant event was the Non-Proliferation Act (NPA), which precluded the transfer of U.S. nuclear technology to South Africa under the NPT. Applied retroactively to all previous agreements and contracts, the NPA constrained South Africa’s ability to export its nuclear technology to other countries and to receive new technology from abroad. Moreover, the NPT’s political isolation was confirmed when Pretoria signed the NPT after the General Assembly had not reached a full equilibrium.

In August 1979, V-Plant operations ceased and the reactor was taken down for a more extensive, catalytic-in-process gas reaction between the UF₆ and the hydrogen carrier gas, a mixture of hydrogen and helium. The process is expensive and machineable, and, when contaminated by certain impurities, can react to form uranium trihalides (UF₃) plus hydrofluoric acid. Although the relevant catalytic impurities were later identified and removed from the process, the V-Plant was not expected to resume operations until April 1980 and it was not until July 1981 that additional HEU was withdrawn. Apart from the 1979 incident, which resulted in a massive gas loss, the plant operated very smoothly during its lifetime. The V-Plant ceased operations in February 1990, and it is now being dismantled under the supervision of the IAEA.²

Building the Weapons

The country’s first full-scale nuclear explosive device, based on a gun-type design, had been completed by the AEB in 1977. Because the V-Plant had not yet produced enough HEU, the device did not contain a HEU core. Nevertheless, the device was intended for a fully instrumented “cold test” (where the test device would contain a depleted uranium core). After the government abandoned the Kalahari test site in August 1977, a cold test of this first device was never carried out.

A second, smaller device built by the AEB in 1978, also intended for an instrumented test, initially lacked a HEU core because of the V-Plant’s limited production capacity. In November 1979, this device was the first to be provided with HEU from the V-Plant, although the uranium had been enriched to only about 80 percent U-235. In 1979, the government decided that the task of designing and building the program’s additional gun-type devices would be assigned to the state-owned Armaments Corporation (ARMSCOR), with the AEB providing the HEU and its expertise in the theoretical and neutron physics. A new AEB design facility, the Pretoria and commissioned in 1981 to begin the work, and all previously manufactured nuclear explosives hardware were transferred to this site from other AEB facilities.

This brief report of the country’s weapons program should help put to rest the speculation as to whether South Africa was responsible for the mysterious “double flash” incident over the South Atlantic Ocean on December 22, 1979, when a U.S. Vela satellite recorded signals suggesting that a nuclear explosion had occurred. Although attention quickly focused on South Africa and Israel as the states most likely to conduct such a test, the scientific community has never been able to definitively explain the event. It is relevant to note, however, that no radioactive fallout was detected by any South African measuring station after this incident. In the 1960s, when the weapons-testing status was conducting atmospheric tests in the Northern Hemisphere, fallout could be measured in South Africa within two weeks of a test. Suggestions that South Africa could design a “clean” nuclear device without any prior testing, much less a gun-type device with a neutron initiator and using uranium that had not been enriched to weapons-grade level (that is, 90 percent or more U-235), are not credible. South Africa was neither responsible for nor involved with any other party in this incident.

The first device built at the new ARMSCOR facility was completed in December 1980. This device was followed at an orderly pace of less than one year per device, essentially matching the production schedule of the U.S. device, and later devices were more sophisticated in terms of their control systems, they remained bulky gun-type devices that lacked As part of its peaceful nuclear explosives program in the mid-1970s, South Africa drilled two test shafts beneath a military testing range in the Kalahari Desert. Although the site was abandoned in 1977, the shafts were reactivated in August 1979. After the additional tests, it remained an important component of the country’s nuclear deterrent strategy that envisioned the possible need to conduct a demonstration test. After Pretoria dismantled its program, the site was sealed in June 1983 under the supervision of the International Atomic Energy Agency (IAEA).
neutron initiators. Theoretically, these
devices could have produced a yield of about
100 kilotons of TNT. The U.S. bomb dropped on
Hiroshima.

Approximately 250 people were
involved in the South Africa's nuclear pro-
gram at any given time, with about 1,000
individuals participating throughout the
years. Given the extra effort and resources the
participants could be considered to have
had nuclear explosives expertise. Due to
issues with the South African government,
only South African-born nationals were em-
ployed on the program; no foreign govern-
ments or external experts were directly
involved in the program. The cost of the
entire South African weapons program is
estimated to be less than 680 million Rand
(about U.S. $500 million at historical ex-
change rates).

The political prospects facing South Africa had not improved noticeably by
the mid-1980s, in September 1985 the
entire weapons effort was reviewed once
again and President Botha reconfirmed that
the program would be limited to seven fus-
ion devices. Furthermore, only very lim-
ited work (mostly theoretical) was allowed to
continue on more advanced concepts involving fusion devices in the future.

The government also reconfir-
mated that the devices would not be em-
ployed and the weapons program would
be maintained as a deterrent. The govern-
ment also announced that the country's three-phase deterrent strategy would be maintained. It was pre-
clear, furthermore, as the progress of
political reforms would depend upon
underground tests was reviled, as an under-
ground test was still a fundamental part of
Phase 3 of the strategy).

Factors Behind Rollback Decision

The confirmation of the program's lim-
its in September 1985 had dual-use impli-
cations for South Africa. The decision
regarding the effect on the weapons effort, and
was, in retrospect, possibly the first sign of
an eventual rollback of the country's nu-
clear deterrent. It also put an end to some
earlier studies on the possible production
versatility of the weapons program. The light-water test reactor that would be used
to develop fuel for the Koeberg reactor. (By
1989, economic constraints halted sub-
sequent plans to turn this project into a
simply commercial demonstration reactor.)

President de Klerk also acknowledged that its accession to the NPT
without substantial domestic political
and public support would have provided
benefits to the country's nuclear programs. Nevertheless, during the decade Pretoria held sporadic discussions with the United

States, as well as Britain and the Soviet
Union (the other two NPT depositary
states) for South Africa's possible accession
to the treaty.

Importantly, in the late 1980s signifi-
cant increases in U.S. and NPT-related in-
vestments started to ease the security situation
around South Africa.

• On August 1, 1988, a cease-fire was
agreed upon for Namibia's northern border,
and on December 22, 1988, South Africa, Angola and Cuba signed a tripartite agreement ensuring a phase-in withdrawal of Cuban forces from Angola.

• On April 1, 1989, implementation be-
gan of UN Security Council Resolution
435/1978, which led to the inde-
dependence of Namibia.

• The visit of the Berlin Olympic team in
December 1989 signaled the imminent collapse of the Soviet empire, and the end of the Cold War superpower rivalry in
Africa appeared inevitable.

These events coincided with the elec-
tion of de Klerk at President in September
1989, who immediately set about further
reforms including the dismantling of the country's nuclear

deterrent. With the removal of the external threat to South Africa, the reorientation of the
country's efforts was decision was received from President de Klerk on February 26, 1990. This date, therefore, marked the official date of implementation of the termi-
nation of South Africa's weapons program.

Dismantlement and NPT Accession

The dismantlement of the high-end of the Y-Plant's cascade started with the removal of theoder procedures
for the safe and secure dismantlement of
the nuclear devices were drawn up in
July 1990, before the dismantlement of the
first device began. President de Klerk
appointed an independent auditor, Wy-
and Foulkes, a former South African and
university president, to independently
audit the entire deruerenalization process to
ensure that no undamaged nuclear materi-
als are left.

The dismantlement process proceeded very slowly as it had to be completed by the end of June, 1991, with the last HEU returned to the IAEA on September 5. After the last HEU was delivered to the IAEA on July 10, 1991, South Africa submit-
ted its initial inventory of nuclear materials and
collections to the IAEA on October 30, 1991, and the agency's first verification
team arrived on-site that November.

President de Klerk asked whether public acknowledgement by South Africa of its nuclear weapons pro-
gress might influence the international
at time of its accession to the NPT. Although a valid question, it is important to remem-
ber that the "grand bargain" argument is based on the pretense that the NPT, which is concerned with a coun-
try's nuclear activities from the date of its accession, does not facilitate the drift toward full military nuclearization. The NPT, for example, does not include comprehensive safeguards covering all types of nuclear facilities, or require a nuclear-armed state to cease work on non-nuclear weapons. Indeed, the NPT specifically excludes the use of "new" nuclear weapons, such as thermonuclear weapons. President de Klerk argued that his country's actions, including the IAEA for inspections "anywhere, any time, any place—within reason." He asked whether public acknowledgement by South Africa of its nuclear weapons pro-
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The IAEA Verification Process

Verification by the IAEA of the com-
pleteness of Pretoria's declaration of nu-
clear materials and facilities was no easy
task, and the agency's experience with South Africa was no guarantee of a successful
future. The NPT is designed to monitor a country's nuclear activities only after it has
ceded to the treaty; it is not really con-
cerned with the state's past actions. But in-
plementation of the NPT in a country with a diversified nuclear program, such as
South Africa, is not the same as the NPT in a
usually does not question the IAEA's
ability to verify fuel cycle activities, and in
actually means that the IAEA has access to field
nuclear field, the IAEA has been to field
nuclear facilities, that could be fired from
long-range howitzers" should be dis-
missed. South Africa produced only

enough HEU for seven nuclear devices. For
the arsenal they have suggested, 20 to 25
tons of HEU would be needed. This is an
cinconceivably large amount of material for
the IAEA to miss during its investigation.
Alternately, South Africa might have been using plutonium and implosion technology, requiring eight to 10
cubic meters of HEU or so, instead of these
initiators, but the IAEA found no trace of plutonium in South Africa despite exten-
sive searches. The IAEA's evaluative authors have invited their findings to the IAEA for analysis, they have
so far refused.

A Commitment to Non-Proliferation

Since the end of the 1980s, South Africa has indicated a commitment to non-proliferation,
attaining full acceptance as a re-
spected member of the international community. This transformation, however, was not pro-
longed by the IAEA or South Africa's willingness to make the detailed verification effective.
South Africa and the IAEA agreed in
October 1991 that the IAEA would verify
the correctness of the South African deter-
nent's and nuclear facilities. The IAEA's
mission was to verify that all nuclear materials and facilities in South Africa had been removed.

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The Zangger Committee and the Nuclear Suppliers Group. South Africa is a member of both export control bodies, and the coun-
try has enacted the necessary legislation to support its nuclear non-proliferation commitments.

On August 16, 1993, an "Act on the Control of Non-proliferation of Weapons of Mass Destruction" was promulgated after having been passed earlier by the South African Parliament. This act makes it a criminal offense to fail to report the acquisition or stockpiling of nuclear weapons or related materials. The act also regulates the export of nuclear materials to ensure that South Africa's nuclear program is not used in a manner that would lead to the proliferation of nuclear weapons or other means of mass destruction.

In 1993, Parliament passed a revised Non-Proliferation of Nuclear Weapons Act, which replaced the Nuclear Non-Proliferation Act of 1985. The Act provided for the establishment of a Nuclear Non-Proliferation Board, which is responsible for regulating the import, export, and use of nuclear materials and components.

In 1998, the government of South Africa signed the Comprehensive Nuclear-Test-Ban Treaty (CTBT), which prohibits all nuclear explosions, including those for peaceful purposes. South Africa has not yet ratified the CTBT, but it has conducted several tests of nuclear weapons in the past.

South Africa's nuclear program is a controversial issue, with some countries and organizations expressing concerns about the potential for proliferation of nuclear weapons.

The Pelindaba Treaty: Africa Joins the Nuclear-Free World

David Fischer

"Pelindaba" has meant anything at all to students of arms control, it has been in connection to the nuclear re-
servation center. In fact, during the 1970s, South Africa conducted much of its secret research and development work on the country's so-called "wet" nuclear weapons capability. (See p. 33) Today, how-
ever, Pelindaba has taken on a distinctly peaceful connotation: The "Pelindaba Treaty" is the informal name of the soon-to-be-signed pact that will establish Africa as the world's fourth nuclear-weapon-free zone (NWFZ). When the treaty enters into force—perhaps as early as next year—it will, along with the 1989 Antarctic Treaty, the 1967 Tlatolco Treaty (for Latin American and Caribbean states) and the 1968 Non-Proliferation Treaty (covering the South Pacific), transform most of the Southern Hemisphere into a zone free of nuclear weapons.

The negotiation of the Pelindaba Treaty has been a long and arduous task. It has taken more than 35 years to complete the treaty since African states first voiced interest in an NWFZ in 1960. In February of that year, France conducted a nuclear test in the southern part of the world that hopefully is now free of the internal threat of nuclear weapons and, with the genesis of a nuclear-weapon-free zone in Africa, free of the imprint of the arsenals of the nuclear-weapon states on African soil.

NOTES

1. In 1982, the Uranium Enrichment Corporation was incorporated, along with the Atomic Energy Board, into the present Atomic Energy Corporation (ACEA).
2. The Pelindaba framework portion of the Y-
Plant's cascade has been fully decommissioned, and the ACEA has been granted approval for the decommissioning module for the ACEA's Molecular Laser be-
to Separation (MSLS) project is being carried out in the United States. Preparation of a full-scale IAEA safeguards, designed for commercial, low-enrichment use of US, in a single step.

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similar resolution the following year. In 1964, African countries intensified their ef-
forts by adopting a "Declaration on the Demilitarization of Africa" at the first

The Pelindaba Treaty will encourage the creation of other nuclear-weapon-free zones, particularly in "Southeast Asia and the Middle East, and set new patterns and precedents for such regional endeavors.

The Pelindaba Treaty has been a long and arduous task. It has taken more than 35 years to complete the treaty since African states first voiced interest in an NWFZ in 1960. In February of that year, France conducted a nuclear test—above ground—in Algeria, during the U.S.-British-Soviet testing moratorium that began in 1963. After three more years, France conducted three additional atmospheric tests in Algeria be-

South Africa looks forward to a future of peaceful coexistence with its neighbors and the world as a whole. The Pelindaba Treaty, translated into action, means "We have concluded discussions."